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IMMEDIATE LEARNING REINFORCEMENT IN A COMPLEX MENTAL-MOTOR SKILL (DRIVER TRAINING) USING MOTION PICTURES, PHASE II.

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THE STUDY ATTEMPTED TO DETERMINE (1) WHETHER THE DRIVING SKILLS, ATTITUDES, AND KNOWLEDGE OF STUDENTS TAUGHT BY A MOVIE-SIMULATOR CENTERED COURSE DIFFERED SIGNIFICANTLY FROM THOSE OF STUDENTS TAUGHT BY DUAL-CONTROL CAR CENTERED COURSE SUPPLEMENTED BY THE SIMULATOR FILMS WITHOUT THE USE OF THE SIMULATOR AND (2) WHETHER INSTRUCTIONAL TIME IN THE SIMULATOR COULD BE REDUCED FROM 9 TO 6 OR 3 HOURS WITHOUT DECREASING LEARNING EFFECTIVENESS. THE STUDY INVOLVED 465 STUDENTS IN TWO HIGH SCHOOLS USING FOUR DIFFERENT TREATMENTS--A CONVENTIONAL TRAINING PROGRAM, A 9-HOUR SIMULATOR CENTERED PROGRAM, A 6-HOUR AND A 3-HOUR SIMULATOR PROGRAM. TEN-DAY CONCENTRATED COURSES WERE APPARENTLY MORE EFFECTIVE AND EFFICIENT THAN COURSES SPREAD OVER APPROXIMATELY 4 WEEKS. GENERALLY THE 6- AND 3-HOUR SIMULATOR COURSE STUDENTS MADE FEWER ERRORS IN PRACTICE DRIVING THAN DID THE 9-HOUR SIMULATOR AND NON-SIMULATOR STUDENTS, AND THE 3-HOUR SIMULATOR COURSE RESULTED IN FEWER PRACTICE DRIVING ERRORS THAN THE 6-HOUR COURSE THOUGH NOT TO A SIGNIFICANT DEGREE. THE SIGNIFICANCE WAS IN THE PRACTICAL AREA OF LESS EXPENSE FOR THE SHORTER TRAINING TIME. APPARENTLY, THE FIRST FOUR INSTRUCTIONAL FILMS WERE THE MOST EFFECTIVE SINCE THEY WERE USED DURING THE FIRST 3 SIMULATOR HOURS. THE USE OF SIMULATOR MOVIES IN THE REGULAR CLASSROOM WITHOUT THE OTHER SIMULATOR EQUIPMENT SEEMED TO BE OF VALUE. GIRLS SEEMED TO HAVE HAD A BETTER CHANCE OF PASSING THE OPERATOR'S LICENSE TEST THE FIRST TIME IF THEY HAD SIMULATOR TRAINING. FILM CONTENT, QUIZZES, THE HARRISBURG DRIVER EDUCATION TEST, THE MODIFIED NEYHART ROAD TEST CHECK LIST, AND TABULAR DATA RELATIVE TO THE EFFECTIVENESS OF THE SIMULATOR TO DIFFERENTIATE BETWEEN GOOD AND POOR STUDENTS ARE INCLUDED. THE FIRST PHASE OF THE STUDY IS DESCRIBED IN ED 003 231. (EM)

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"Immediate Learning Reinforcement in a Complex Mental - Motor Skill (Driver Training) Using Motion Pictures - Phase II"

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THE PROBLEM

During the 1963-64 school year, a study of immediate learning reinforcement in driver education had indicated that nine hours of simulation could be substituted for three hours of the usual six hours of behind-the-wheel dual-control car instruction. Since in a dual-control car there is either a 2 to 1 or a 3 to 1 student-teacher ratio, the new simulator with its 12 to 1 student-teacher ratio appeared to be a means whereby many more students could be trained per instructor per year.[1]

The simulator in question presents instructional films which have been connected electronically with each of 12 simulated cars. A standardized programmed sequence from easy to difficult tasks is provided by 12 movies with immediate learning reinforcement of the same nature, time, and place. If the student reacts incorrectly to the traffic situation depicted by the motion picture, a warning red light appears on the student's private error identification panel. Then the student must correct the error in speed, or steering, or turn-signals, or brakes, or headlights. The student knows that he is performing correctly when no red lights appear. Thus, each student knows immediately whether he is performing correctly or incorrectly.

This project was a continuation of the 1963-64 study. During 1964-65 the study not only sought to evaluate a ratio of 2.25 hours of simulation for one hour of actual practice driving instruction, but also 1.5 to 1 and 0.75 to 1 ratios were tested. Another group studied the simulator movies in regular classrooms rather than in the simulator. This was an attempt to not only try to find more effective ways of using the simulator, but also to see if the simulator movies could be profitably used in regular-size classrooms without the simulator equipment.

OBJECTIVES

This experiment sought to answer these questions:

1. Will the driving skills, attitudes, and knowledge of students taught by a movie-simulator centered course differ significantly from the driving skills, attitudes and knowledge of students taught by a dual-control car centered course supplemented by the simulator films without the use of the simulator?

2. Can instructional time in the simulator be reduced from nine to six hours without decreasing learning effectiveness?

3. Can instructional time in the simulator be reduced to three hours without decreasing learning effectiveness?

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[1] Robert B. Hayes et. al., "Immediate Standardized Learning Reinforcement to a Complex Mental-Motor Skill (Driver Training) Using Electronically-Coordinated Motion Pictures," Bureau of Research, Department of Public Instruction, Harrisburg, Pennsylvania, 1964.

PROCEDURES

Subjects and Treatments

This study involved 465 high school students. The students were enrolled in the William Penn and the John Harris High Schools of Harrisburg, Pennsylvania. These are two public high schools of a city of approximately 100,000 people. The city is the State capitol and it also has a variety of industries and a wide range of socio-economic levels.

Students were assigned randomly to treatments. During the regular school year 167 students received the conventional program (Treatment A) of 6 hours of behind-the-wheel training, 6 hours of observation in the dual-control cars, and 30 hours of classroom instruction. During this class time the simulator films were shown in a classroom of some 35 students. Before showing each film the students were advised that a written quiz would be given on film content. These tests (See Appendix A) followed immediately after the films and then the movies were discussed to emphasize learning objectives. The purpose of this treatment (A) was to see if the simulator movies could be used profitably in regular classrooms without the other simulator equipment. In both Treatments A and B, students averaged four weeks in completing the driver training course.

During the regular school year 161 students received a nine hour simulator centered program (Treatment B) with only 4 hours of behind-the-wheel training and 4 hours of car observation. They also received 30 hours of classroom instruction. Here the simulator movies were used only in the simulator. The simulator was used in an integrated manner with simulator instruction interwoven with dual-control car training as follows:

Period	Number of Minutes	Content
1	45	"Introductory Film"
2	45	"Start of Good Driving" - (twice)
3	40	½ driving, ½ observation
4	40	½ driving, ½ observation
5	45	"The Good Turn" - (twice)
6	45	"City Driving" and "Highway Driving"
7	40	½ driving, ½ observation
8	40	½ driving, ½ observation
9	45	"Advanced City Driving" - (twice)
10	45	"Expressways" and "Shift for Yourself"
11	40	½ driving, ½ observation
12	40	½ driving, ½ observation
13	45	"Shift for Yourself" and "Parking"
14	45	"Driving After Dark"
15	40	½ driving, ½ observation
16	40	½ driving, ½ observation
17	45	"Let's Review"
18	40	½ driving, ½ observation

During the summer 75 students received a 6 hour simulator course (Treatment C), and another 62 students received a 3 hour simulator course (Treatment D).

In both Treatments C and D, students were given 4 hours of behind-the-wheel and 8 hours of car observation training in a dual-control car. In the 6 hour simulator approach students reacted to the first eight movies. In the 3 hour simulator treatment, pupils were taught with the first five movies. In both Treatments C and D, students normally completed the training in 10 days.

In all cases of simulator instruction (Treatments B, C, and D), the integrated teaching approach was used to facilitate transfer from simulation to the dual-control car. Each movie was introduced with approximately a four minute briefing to clarify objectives and to motivate students. Students were directed to raise their hand when in trouble so that individual help could be given. When either several hands were raised simultaneously or many red lights flashed in the same area at the same time, the movie was stopped so the difficulty could be clarified by the teacher. Then the film was continued at an appropriate place. After each movie important points were emphasized and students were advised of their errors by red light areas which had been recorded by the master error counter for each of the 12 learning stations.

Sex differences were controlled by attempting to have the same number of boys and girls trained by each instructor and in each treatment. The actual percentages by sex and treatment were:

Treatment	Percent Boys	Girls
A	45	55
B	49	51
C	43	57
D	44	56
Total	46	54

Control of Teacher Variable

The two driving instructors at each high school both taught approximately the same number of students by Treatments A and B during the regular school year. During the summer a team teaching approach was employed for Treatments C and D. Each instructor received the same amount of supervision and training. All four instructors had used the simulator during the preceding school year.

Pre-experimental Variables

The pre-course instruments for students in Treatments A and B were the Lorge-Thorndike Intelligence Test, the Siebrecht Attitude Scale, the 1962 Knowledge Test of the American Automobile Association, and a knowledge test (See Appendix B) devised by the involved instructors. For all students, data was collected for sex, age, and prior year's grade average. Hours of driving outside the school course

were obtained from students by two independent judges and again three to five days later by their instructors.

Criterion Variables

Both knowledge tests (named above) and the Siebrecht Attitude Scale were administered to students in Treatments A and B at the end of the 1964-65 school year. Also a record of simulator errors was maintained for each simulator student for each movie. A Neyhart Road Skill Check List for Passenger Car Drivers was completed by one of two independent judges during both the fourth and final twenty minute periods of behind-the-wheel of a dual-control car. The Neyhart rating scale (See Appendix C) had been modified to delete items which did not pertain to either an automatic shift car or to the particular road course used in this experiment. Another criterion was the number of times each student needed to pass the State Operators License Examination. In addition, accident and traffic violations were analyzed for students who had participated in a similar experiment in the 1963-64 school year.

Analysis of Data

Coefficients of correlations were computed to obtain insight into various relationships of IQ, attitude, knowledge, age, grade average, simulator errors, dual-control car driving errors, etc. Chi-square was employed to compare simulator errors with dual-control car driving errors, and to compare simulator students versus non-simulator students in such areas as number of times required to pass the State Operators License Examination. Analysis of variance was used to compare the simulator and non-simulator students on attitude, knowledge, dual-control driving errors, etc. Where analysis of variance indicated significant differences between means, Kramer's extension of Duncan's new multiple range test for unequal cases was used.[10] Covariance was used when analysis of variance was inadequate for the comparison of the appropriate criterion variables.

RESULTS

Pre-experimental Variables

The only pre-experimental variable which resulted in a statistically significant difference among means was hours of driving outside of school course.

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[10]Clyde Y. Kramer, "Extension of Multiple Range Tests to Group Means With Unequal Numbers of Replications," Biometrics, Vol. 12, September 1956, pp. 307-310.

TABLE 1

AVERAGE HOURS DRIVEN OUTSIDE OF SCHOOL

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator
4.99	3.98	3.87	2.21

The difference between (A) and (D) was significant at the .01 level while the differences between (B) and (D) and (C) and (D) were significant at the .05 level. A low but statistically significant correlation (for 465 students) of -.15 was obtained between hours of outside driving and number of errors made in the fourth and final periods behind-the-wheel of a dual-control car. Also a low but statistically significant correlation of -.13 was obtained between hours of outside driving and number of times to pass the skills section of the State Operator's License Examination. Other data on the pre-experimental variables are reported in Appendix D.

Coefficients of Correlation

Other statistically significant coefficients of correlations obtained in this study were as follows:

Variables	r
IQ and Harrisburg Post-Knowledge Test:	.39
IQ and AAA Post-Knowledge Test:	.35
IQ and Siebrecht Post-Attitude Test:	.37
Preceding Year Grade Average and Harrisburg Post-Knowledge Test:	.34
Preceding Year Grade Average and AAA Post-Knowledge Test:	.25
Preceding Year Grade Average and Siebrecht Post-Attitude Test:	.24
Fourth and Final Period Total Errors:	.42
Fourth Period Errors and Times to pass State Operators Skills Test:	.24
Final Period Errors and Times to pass State Operators Skills Test:	.18

Fourth Period Dual-Control Car Steering Errors

Which treatment better prepared students for the fourth period of practice driving in the area of steering?

TABLE 2

AVERAGE STEERING ERRORS FOR FOURTH DRIVING PERIOD

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
2.58	3.16	1.37	1.37	2.43

Analysis of variance resulted in an F ratio of 3.41239 which exceeded the .05 level of significance. The differences between (B) and (D) and between (B) and (C) were significant at the .05 level. The other differences between pairs of means were not statistically significant.

Fourth Period Dual-Control Car Speed Errors

Which treatment better prepared students for the fourth period of practice driving in the area of speed?

TABLE 3

AVERAGE SPEED ERRORS FOR FOURTH DRIVING PERIOD

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
1.83	2.33	0.80	1.26	1.76

Analysis of variance resulted in an F ratio of 3.40504 which exceeded the .05 level of significance. The difference between (B) and (C) was significant at the .05 level. The other differences between pairs of means were not statistically significant although differences between (A) and (C) and (B) and (D) closely approached the .05 level.

Fourth Period Dual-Control Car Turn-Signal Errors

Which treatment better prepared students for the fourth period of practice driving in the area of turn-signals?

TABLE 4

AVERAGE TURN-SIGNAL ERRORS FOR FOURTH DRIVING PERIOD

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
0.38	0.40	0.32	0.35	0.37

Analysis of variance produced an F ratio of 0.10294 which was not significant.

Fourth Period Dual-Control Car Braking Errors

Which treatment better prepared students for the fourth period of practice driving in the area of braking?

TABLE 5

AVERAGE BRAKING ERRORS FOR FOURTH DRIVING PERIOD

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
1.53	1.52	1.08	0.73	1.35

Analysis of variance resulted in an F ratio of 1.13501 which was not statistically significant. Independent statistical comparison of (A) and (D) also indicated no significant difference.

Fourth Period Dual-Control Car Total Errors

Which treatment better prepared students for the fourth period of practice driving when all errors were totalled?

TABLE 6

AVERAGE TOTAL ERRORS FOR FOURTH DRIVING PERIOD

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
25.74	29.39	25.52	23.23	26.63

The above means were analyzed using hours of outside driving as a covariate. Hours of outside driving correlated significantly (-.15) with fourth period total errors whereas hours of outside driving had not correlated significantly with errors for any of the following: steering, speed, turn-signals, or braking. Analysis of covariance for fourth period total errors produced an F ratio of 1.89792 which was not significant. Separate statistical comparison of (B) and (D) also indicated no significant difference.

Final Period Dual-Control Car Steering Errors

Which treatment better prepared students for the final period of practice driving in the area of steering?

TABLE 7

AVERAGE STEERING ERRORS FOR FINAL DRIVING PERIOD

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
1.07	1.20	0.36	0.47	0.92

Analysis of variance produced an F ratio of 2.7255 which was significant at the .05 level. The difference between means for (B) and (C) were significantly (.05 level) in favor of the 6-hour simulator group. Other differences between pairs of means did not prove to be significant.

Final Period Dual-Control Car Speed Errors

Which treatment better prepared students for the final period of practice driving in the area of speed?

TABLE 8

AVERAGE SPEED ERRORS FOR FINAL DRIVING PERIOD

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
2.94	2.47	1.71	1.00	2.32

Analysis of variance resulted in an F ratio of 3.0575 which exceeded the .05 level of significance. The difference between means for (A) and (D) and (B) and (D) were significantly in favor of the 3-hour simulator group at the .05 level. Other differences between pairs of means did not prove to be significant.

Final Period Dual-Control Car Turn-Signal Errors

Which treatment better prepared students for the final period of practice driving in the area of turn-signals?

TABLE 9

AVERAGE TURN-SIGNAL ERRORS FOR FINAL DRIVING PERIOD

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
0.90	0.66	1.07	0.71	0.82

Analysis of variance produced an F ratio of 1.53544 which was not statistically significant.

Final Period Dual-Control Car Braking Errors

Which treatment better prepared students for the final period of practice driving in the area of braking?

TABLE 10

AVERAGE BRAKING ERRORS FOR FINAL DRIVING PERIOD

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
0.78	0.73	0.53	0.16	0.64

Analysis of variance resulted in an F ratio of 1.46421 which was not statistically significant.

Final Period Dual-Control Car Total Errors

Which treatment better prepared students for the final period of practice driving when all errors were totalled?

TABLE 11

AVERAGE TOTAL ERRORS FOR FINAL DRIVING PERIOD

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
16.93	16.36	14.23	11.44	15.78

The above means were adjusted for significant pre-experimental differences among treatments in hours of outside driving by students. The preceding variable

correlated significantly with final period total errors, although it had not correlated significantly with individual error areas in the final period of driving. Analysis of co-variance resulted in an F ratio of 2.76439 which was significant at the .05 level (for 3,460 degrees of freedom, the F table value is 2.62). When possible pairs of means were compared, the differences between (A) and (D) and (B) and (D) were significant at the .05 level in favor of the 3-hour simulator group.

Treatment Differences According to Sex

In a prior study the girls (but not the boys) had a significantly higher probability of passing the State Drivers License Skills Test the first time if they had learned to drive with an integrated simulator approach.[2] Did girls have an easier time passing the State Operators License Skills Test on the first occasion if they were trained in this study with one of the simulator programs? Yes, but not significantly so. In comparing the four groups of girls, a chi-square value of 4.21976 resulted which did not satisfy the .05 level of significance (for three degrees of freedom). Taken collectively, 54 percent of all the girls trained in the simulator passed the State Skills Test the first time compared to 42 percent of the non-simulator girls.

TABLE 12

PERCENTAGE BY SEX PASSING STATE SKILLS TEST FIRST TIME

	(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator
Girls	42	52	60	49
Boys	67	71	80	81

In this study the boys also had a somewhat easier time of passing the State Operators License Skills Test the first time if they were trained with one of the simulator programs. In comparing the four groups of boys, a chi-square value of 3.75797 resulted which did not satisfy the .05 level of significance (for three degrees of freedom). Taken collectively, 75 percent of all the boys trained in the simulator passed the State Skills Test the first time compared to 67 percent of the non-simulator boys.

Road Skills Section of Drivers License Exam

Which treatment better prepared all students to pass the road skill part of

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[2] Ibid., p. 10.

a State License Examination? No statistically significant differences appeared among treatments; analysis of variance resulted in an F ratio of 0.41921.

TABLE 13

AVERAGE NUMBER OF TIMES TO PASS STATE SKILLS TEST

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
1.56	1.52	1.33	1.47	1.50

Knowledge Section of Drivers License Exam

Which treatment better prepared students to pass the knowledge part of a State License Examination? No statistically significant differences appeared among treatments; analysis of variance resulted in an F ratio of 1.72466.

TABLE 14

AVERAGE NUMBER OF TIMES TO PASS STATE KNOWLEDGE TEST

(A) Non-Simulator	(B) 9 Hour Simulator	(C) 6 Hour Simulator	(D) 3 Hour Simulator	Average For All 465 Students
1.05	1.08	1.00	1.06	1.06

Driving Knowledge Section of Harrisburg Knowledge Test

Analysis of covariance, using I.Q. and preceding year's grade average as covariates, resulted in an F ratio of 6.43532 which was significant at the .05 level (the table value is 6.73 at the .01 level for 1,325 degrees of freedom).

TABLE 15

AVERAGE HARRISBURG KNOWLEDGE TEST SCORES

(A) Non-Simulator	(B) 9 Hour Simulator	Average For All 328 Students
38.67	39.69	39.13

Driving Knowledge Per AAA Test

No statistically significant differences appeared among treatment means for results on the 25-item American Automobile Association knowledge test. Analysis of variance resulted in an F ratio of 0.63817.

TABLE 16

AVERAGE AAA KNOWLEDGE TEST SCORES

(A) Non-Simulator	(B) 9 Hour Simulator	Average For All 328 Students
13.86	14.11	13.98

Attitudinal Results

Which treatment resulted in better attitude? The 40-item Siebrecht Attitude Scale was used with local modifications for simplified scoring. The scoring was dichotomized so that a correct answer was scored as one and incorrect answer as zero. Answers of either "Strongly Agree" or "Agree" were counted the same since words mean different things to different people and "Strongly Agree" means to some what "Agree" means to others. Likewise a response of "Disagree" or "Strongly Disagree" were counted the same. In view of the preceding decisions, items 1,9, 22, and 31 were not counted at all since "Undecided" is the coded response. No statistically significant differences appeared among treatment means; analysis of variance resulted in an F ratio of 0.81515.

TABLE 17

AVERAGE ATTITUDE SCORES

(A) Non-Simulator	(B) 9 Hour Simulator	Average For All 328 Students
29.81	30.30	30.05

Ability of Simulator to Differentiate Between Good and Poor Students

Are students with a low simulator error rate better prepared for driving than students with a high simulator error rate? The answer was not significantly better (See Appendix E).

CONCLUSIONS AND IMPLICATIONS

Ten-day concentrated courses in learning to operate a car are apparently more effective and efficient than courses which are spread out over approximately four weeks. Both the six- and three-hour simulator courses had been taught in the summer when a ten-day concentrated course was easy to schedule. Scheduling difficulties during the regular school term resulted in students taking an average of four weeks to complete either the nine-hour simulator or the non-simulator courses. Generally the six- and three-hour simulator course students made fewer errors in practice driving than did the nine-hour simulator and non-simulator students.

Of the two concentrated courses, the three-hour simulator course usually resulted in fewer student errors in practice driving than did the six-hour simulator course. These differences were not statistically significant. A practical difference is three fewer hours of instruction for the three-hour compared to the six-hour simulator course. Apparently the first four movies, subsequent to the introductory film, are the most effective of the instructional films, since these four movies are used in the first three hours in the simulator.

The use of the simulator movies in a regular classroom without the other simulator equipment appears to be of value. The non-simulator course students compared favorably to the nine-hour simulator students in such areas as fourth and final periods of practice driving and the number of times required to pass the State Operators License Examination.

The significant correlations obtained between the fourth and final period errors in practice driving and between these errors and times required to pass the skills section of the State Operators License Examination indicate satisfactory reliability and validity for the modified Neyhart Road Test Check List for Passenger Car Drivers. The correlation coefficient between the fourth and final period driving errors was the same this year as in the 1963-64 study; this may be considered as additional evidence of the reliability of the Neyhart Check List.

Once again, as in the previous year, there was evidence that girls have a somewhat better chance of passing the State Operators License Examination the first time if they have had simulator training.

With an integrated teaching approach during a concentrated time period of some ten days, it is indicated that three hours of simulation with immediate learning reinforcement and four hours of behind-the-wheel instruction in a dual-control car can be substituted for six hours of behind-the-wheel instruction in a dual-control car. The practical advantage is that twelve students can be trained per instructor in the simulator compared to two or three students in the dual-control car. Assuming that each driving instructor has four hours per school day and 180 school days to train students to drive a car, the instructor would have 720 hours in which 120 students could be trained, two at a time, using 12 hours for car instruction in the standard conventional course. With the same 720 hours per year, 169 students could

be trained in the three-hour simulator and four-hour dual-control car course (169 x 3 divided by 12 equals 43 simulator instructional hours plus 169 x 8 divided by 2 equals 676 instructional car hours; 43 plus 676 equals 719 hours of total instruction). This would mean an increase of 41 percent in the number of students trained per instructor per year, compared with the present conventional standardized program. This would also mean that three instructors could train more students with the three-hour simulator program than four instructors could train with the standard conventional program. The saving of one instructor's salary would pay for the simulator within five years. The average driving instructor in Pennsylvania makes approximately $5600 per year. Since the simulator costs approximately $26,500, the cost of the simulator (including normal preventative maintenance and film repair) would be amortized within five years.

APPENDIX A

FILM CONTENT QUIZZES

I. Start of Good Driving

Number the following steps in the Starting Proceedure in their correct order.

1. _____ Acceleration
2. _____ Selector Lever to "Neutral"
3. _____ Release Parking Brake
4. _____ Selector Lever To Drive
5. _____ Take Slack From Foot Brake
6. _____ Start Engine
7. _____ Signal
8. _____ Check Traffic, Front, Sides and Rear

Number the following steps in the Stopping Proceedure in their correct order.

1. _____ Check Traffic Behind
2. _____ Lane Position
3. _____ Signal
4. _____ Release Gas Pedal
5. _____ Brake Lightly
6. _____ Slight Hand and Wheel movement toward curb
7. _____ After Stopping Set Hand Brake

APPENDIX A (CONTINUED)

II. The Good Turn

True or False

1. A turn signal must always precede a left or right turn.
2. The front wheels turn the same way as the steering wheel.
3. To signal for a left turn the signal lever is up.
4. When turning at an intersection you should enter the lane that corresponds to the lane that you left.
5. It is good driving procedure to brake while making a turn.
6. Cars making a left turn have the right of way over traffic coming straight thru the intersection.
7. Right turns are always made from the extreme right lane.
8. Speed should be reduced before starting to make a turn.
9. When turning hand over hand the fingers may be placed under the steering wheel.
10. A good turn recovery can be made by letting the wheel slide back through your hands.

APPENDIX A (CONTINUED)

III. CITY DRIVING

Completion--write in the word or words to complete the following statements:

_____1. As speed increases, following distance should _____ proportionately.

_____2. A safe following distance can be determined by allowing one car length for each _____ miles per hour.

_____3. On a one way street a left turn is made from the _____ lane.

_____4. A complete stop may not be necessary at an intersection controlled by a _____ sign.

_____5. Turning the wheel too much on a slight curve is called _____.

_____6. When passing a line of parked cars always watch out for the _____ on the traffic side.

_____7. A turning vehicle must always yield the right of way to _____.

_____8. A good driver should always anticipate danger by _____ the _____.

_____9. Before changing lanes always check traffic and _____.

_____10. A good driver avoids traffic conflicts by _____ them in time to do something about it.

APPENDIX A (CONTINUED)

IV. HIGHWAY DRIVING

1. Busses and Fuel carriers _____ at railroad crossings.
2. List the proper procedure to follow when passing another vehicle.

   A.

   B.

   C.

   D.

   E.

   F.

3. Name three places where a driver is not allowed to pass another vehicle.

   A.

   B.

   C.

4. What should you do when you see an emergency vehicle approaching you on the highway?

   A.

5. List three factors that determine a safe speed for driving a motor vehicle?

   A.

   B.

   C.

6. It is always illegal to pass a parked school bus discharging students _____ (True or False)

APPENDIX A (CONTINUED)

V. ADVANCED CITY DRIVING

1. List two benefits of one way streets.

   A.
   B.

2. List two ways to identify one way streets.

   A.
   B.

3. In heavy traffic, you should leave the vehicle from the _____ side.

4. What should a driver do before changing traffic lanes?

   A.
   B.

5. List two problems that can be expected on one way streets.

   A.
   B.

6. A left turn from a one way street must be made from the _____ lane.

7. On a three lane, one way street, the _____ lane is usually the least congested and will move more traffic.

APPENDIX A (CONTINUED)

VI. EXPRESSWAY DRIVING

1. Expressways are designed for safety. List three safety features:

   A.

   B.

   C.

2. All expressways have some potential dangers. List two hazards that can be expected.

   A.

   B.

3. What name is given to the lane leading off the expressway to an exit?

   _____

4. What name is given to the lane leading on to the expressway from an entry road?

   _____

5. At a cloverleaf intersection the first exit ramp is for a _____ turn and the second exit ramp is for a _____ turn.

6. How can you request assistance if you have a mechanical breakdown on the expressway?

   _____

APPENDIX B

HARRISBURG CITY SCHOOLS
Driver Education Knowledge Test

Name_____ Date_____

Instructor_____ Period_____

Part I

Write the letter of the best answer in the blank at the left.

_____ 1. You must submit an accident report if you are involved in an accident where property damage exceeds (a) $25.00, (b) $50.00, (c) $100.00, (d) $500.00.

_____ 2. What does a traffic light flashing yellow indicate to you? (a) caution, (b) danger, (c) stop, (d) construction.

_____ 3. At a speed of 50 m.p.h., the total stopping distance is (a) 66 ft., (b) 111 ft., (c) 200 ft., (d) 166 ft.

_____ 4. The date on which registration plates expire for passenger cars is (a) January 31, (b) July 31, (c) March 31, (d) October 31.

_____ 5. A safe night-time speed is primarily determined by the limits of (a) headlights, (b) weather, (c) posted speeds, (d) traffic.

_____ 6. The first thing a driver must do when involved in an accident is (a) call police, (b) stop, (c) assist injured, (d) make report.

_____ 7. You are permitted to use the high beam headlights providing there are no cars approaching within (a) 200 ft., (b) 400 ft., (c) 500 ft., (d) 500 yds.

_____ 8. To make a left turn from a one-way street, a driver should place his car (a) along the left curb, (b) center lane, (c) right lane, (d) any lane.

_____ 9. The distance you must park your car from a fire hydrant is (a) 10 ft., (b) 15 ft., (c) 25 ft., (d) 30 ft.

_____ 10. A motor vehicle must be inspected (a) each month, (b) each year, (c) twice a year, (d) every two years.

_____ 11. Each inspection period lasts (a) one month, (b) 3 months, (c) 6 months, (d) one year.

_____ 12. You may park (a) 10 ft., (b) 15 ft., (c) 25 ft., (d) 30 ft. from a stop sign.

_____ 13. A traffic light flashing red means (a) stop, (b) slow, (c) danger, (d) men working.

APPENDIX B (CONTINUED)

_____ 14. The minimum distance of clear highway necessary for safe passing is (a) 200 ft., (b) 400 ft., (c) 500 ft., (d) 600 ft.

_____ 15. When a driver hears the siren of an approaching emergency vehicle, he should (a) slow down, (b) drive to the right, (c) stop, (d) drive to the right and stop.

_____ 16. When stopping for a school bus that has stopped on the highway, you must stop (a) 10 ft., (b) 20 ft., (c) 30 ft., (d) 50 ft. from the bus.

_____ 17. Driving an automobile in Pennsylvania is a (a) right, (b) duty, (c) privilege, (d) pleasure.

_____ 18. You must make an accident report within (a) 12 hrs., (b) 24 hrs., (c) 48 hrs., (d) 90 days.

_____ 19. In addition to his operator's license, a driver must have in his possession (a) insurance card, (b) vehicle registration card, (c) credit card, (d) social security card.

_____ 20. You may park no closer to a railroad crossing than (a) 10 ft., (b) 20 ft., (c) 30 ft., (d) 50 ft.

_____ 21. According to records, the most frequent cause of trouble on the road is (a) out of gas, (b) ignition, (c) tires, (d) carburetor.

_____ 22. The type of insurance most important for every car owner is (a) fire, (b) theft, (c) liability, (d) collision.

_____ 23. The shape of the traffic sign to indicate a railroad grade crossing is (a) oblong, (b) hexagonal, (c) round, (d) square.

_____ 24. As you increase speed, your danger zone (a) widens only, (b) lengthens only, (c) lengthens and widens, (d) shortens.

_____ 25. The traffic sign you expect as you enter an expressway is (a) yield, (b) slow, (c) stop, (d) one-way.

Part II

Mark + for true and 0 for false.

_____ 26. As a rule motorists under 20 years of age are safer drivers than those over 40 years of age.

_____ 27. When you intend to turn or stop, the law does not require you to give a signal unless there is a vehicle following yours.

_____ 28. If you become sleepy while driving, it is best to drink coffee or take anti-doze pills.

APPENDIX B (CONTINUED)

_____ 29. If one side of the front tires are worn more than the other, the trouble is likely to be wheels out of alignment.

_____ 30. A driver who is emotionally immature is most likely to express anger by driving recklessly.

_____ 31. A common habit of a discourteous driver is to use the horn frequently.

_____ 32. In crossing slippery street car tracks, you should slow down and turn abruptly across the tracks at a wide angle.

_____ 33. When you back your car, you have the right of way because you cannot see very well while backing.

_____ 34. The amount of alcohol in one cocktail is sufficient to decrease one's keenness of vision.

_____ 35. It requires the same distance to slow down from 60 m.p.h. to 50 m.p.h. as it does from 40 m.p.h. to 30 m.p.h.

_____ 36. Defective eyesight will affect a driver more adversely in night driving than in day driving.

_____ 37. It is necessary to slow down at an unprotected intersection if you do not see any cross traffic.

_____ 38. If a driver seriously injures a pedestrian, legally at fault, the driver does not have to make an accident report.

_____ 39. When you drive out of a gas station, street traffic on your left has the right of way.

_____ 40. A rear view mirror can be relied upon for a complete view of what's behind your car.

_____ 41. You may legally exceed the speed limit when you are driving an injured person to the hospital.

_____ 42. More fatal accidents take place on clear, dry days than on stormy days.

_____ 43. New non-skid tires have done away with the danger of skidding on wet pavements.

_____ 44. If your temperature gauge does not reach normal after a mile of driving, it usually means a defective thermostat.

APPENDIX B (CONTINUED)

_____ 45. The odometer shows the condition of the car's battery.

_____ 46. A full fuel tank prevents water formed by condensation.

_____ 47. The function of the carburetor is to vaporize gasoline.

_____ 48. Field of vision is your ability to see from side to side.

_____ 49. Loss of oil pressure can cause permanent damage to the engine of a car.

_____ 50. Good depth perception is most important when passing another car.

APPENDIX C

Modified Neyhart
ROAD TEST CHECK LIST
For Passenger Car Drivers

Name_____ Date_____

School_____ Checked by_____

Instructor_____ Total Deductions_____

		DE-DUCT				
1.	CHECKING THE DRIVER					
	A. Fails to adjust seat properly	1	___	___	___	___
	B. Fails to adjust rear-view mirrors	3	___	___	___	___
	C. Fails to use seat belt	3	___	___	___	___
2.	STARTING THE VEHICLE					
	A. Selects wrong gear or selector lever position	3	___	___	___	___
	B. Does not release parking brake	1	___	___	___	___
	C. Fails to use brake when moving selector lever	3	___	___	___	___
3.	BACKING					
	A. Fails to look to the rear while backing	5	___	___	___	___
	B. Backs jerkily	2	___	___	___	___
	C. Oversteers and zigzags when backing	2	___	___	___	___
4.	STEERING					
	A. Places hands in unstable position on wheel	2	___	___	___	___
	B. Steers abruptly, not smoothly	5	___	___	___	___
	C. Rests arm on window	2	___	___	___	___
	D. Uses one hand habitually	2	___	___	___	___
5.	POSITION ON ROADWAY					
	A. Fails to drive in proper lane	5	___	___	___	___
	B. Straddles traffic lanes (marked or unmarked)	5	___	___	___	___
	C. Straddles at signal or sign when stopping	5	___	___	___	___
	D. Follows too close to other vehicles	5	___	___	___	___
	E. Drives too close to other vehicles, moving objects, etc.	3	___	___	___	___
6.	SPEED CONTROL					
	A. Too fast for conditions	10	___	___	___	___
	B. In excess of marked speed limits	5	___	___	___	___
	C. Too slow for conditions	2	___	___	___	___
	D. Brakes on curves	5	___	___	___	___

APPENDIX C (CONTINUED)

7.	SIGNALING FAILURES				
	A. Turning-fails to signal	2	___	___	___ ___
	B. Leaves turn signal on after turning	2	___	___	___ ___
	C. Does not signal moving from lane to lane	2	___	___	___ ___
	D. Uses horn improperly or fails to use horn	2	___	___	___ ___
8.	SIGNAL VIOLATIONS				
	A. Traffic signal (through on amber)	3	___	___	___ ___
	B. Traffic signal (through on red)	10	___	___	___ ___
	C. Traffic officer	10	___	___	___ ___
9.	UNCONTROLLED INTERSECTIONS OR THROUGH STREETS				
	A. Fails to slow down with intent to stop if necessary	3	___	___	___ ___
	B. Fails to look in all directions	5	___	___	___ ___
	C. Fails to respond to hazardous traffic conditions in the making	10	___	___	___ ___
	D. Fails to yield right of way	10	___	___	___ ___
10.	STOP STREETS				
	A. Fails to come to full stop	10	___	___	___ ___
	B. Fails to stop in a position to see roadway to the right and left	5	___	___	___ ___
	C. Hesitates too long for conditions	3	___	___	___ ___
11.	TURNING (Right)				
	A. Approaches from improper lane	3	___	___	___ ___
	B. At improper speed (too fast or too slow)	2	___	___	___ ___
	C. In improper lane during turn	3	___	___	___ ___
	D. Into improper lane after turn	3	___	___	___ ___
	E. Strikes curb	3	___	___	___ ___
	F. Makes turn unnecessarily wide	1	___	___	___ ___
	G. Shies away, then turns right	2	___	___	___ ___
	H. Fails to yield right of way	10	___	___	___ ___
12.	TURNING (Left)				
	A. Approaches from improper lane	3	___	___	___ ___
	B. At improper speed (too fast or too slow)	2	___	___	___ ___
	C. In improper lane during turn	3	___	___	___ ___
	D. Into improper lane after turn	3	___	___	___ ___
	E. Cuts corner too short	1	___	___	___ ___
	F. Cuts corner too wide	1	___	___	___ ___
	G. Shies away, then turns left	2	___	___	___ ___
	H. Fails to yield right of way	10	___	___	___ ___

APPENDIX C (CONTINUED)

13.	STOPPING					
	A. Before necessary at signals and signs	1	___	___	___	___
	B. Not soon enough (over-running crosswalk or avoidance zone line)	2	___	___	___	___
	C. Not at a safe place (too close to other vehicles, etc.)	5	___	___	___	___
	D. Stalls engine	5	___	___	___	___
14.	SMOOTHNESS OF OPERATION					
	A. Uses brakes roughly or unevenly	5	___	___	___	___
	B. Fails to hold accelerator steady	5	___	___	___	___
15.	PASSING OTHER VEHICLES GOING IN SAME DIRECTION					
	A. Fails to make sure road ahead and behind is clear	10	___	___	___	___
	B. Passes at intersection	10	___	___	___	___
	C. Cuts back into line too soon after passing	5	___	___	___	___
	D. Passes by weaving through traffic	5	___	___	___	___

16. NERVOUS AND HESITANT

Not at all	0
Occasionally	5
Often	10
All the time	15

OVERCONFIDENT

Not at all	0
Part of time	5
Cocky	10

FAILS TO USE REAR-VIEW MIRRORS

Not at all	0
Part of time	3
Over entire route	5

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APPENDIX D

Pre-Experimental Variables

Variables	MEANS Non-Simulator	9 Hour Simulator	6 Hour Simulator	3 Hour Simulator	S. D. For Total	F Ratio
Age	16-10	16-9	16-9	16-1	10.38[b]	1.163
Hours of Outside Driving[c]	4.99	3.98	3.87	2.21	4.85	5.215*
I.Q.	104.46	107.35	106.37	105.40	14.98	1.06
Grade Average[a]	76.58	78.16	77.55	77.03	7.98	1.11
Harrisburg Pre-Knowledge Test	33.76	33.83			4.86	0.007
AAA Pre-Knowledge Test	11.12	11.19			2.80	0.038
Siebrecht Attitude Test	29.43	29.83			5.23	0.480

a - Sophomore grade average in all school subjects.

b - Standard Deviation in months whereas age means are in years and months.

c - As an index of stability reliability the coefficients of correlations between number of hours of outside driving as reported by students to the independent judges and again three to five days later to their instructors were: .93 for non-simulator, .87 for 9 hour simulator, .96 for 6 hour simulator, .90 for 3 hour simulator, and .90 for all 465 students.

* - Significant at .01 level; for 3 and 461 degrees of freedom, the table value at the .01 level is 3.83.

APPENDIX E
Ability of Simulator to Differentiate Between Good and Poor Students

NINE HOUR SIMULATOR ERRORS COMPARED TO
FOURTH PERIOD DRIVING ERRORS

% Students by Errors in Simulator	% Students by Fourth Period Car Errors	
	Below Median	Above Median
Below Median	56	44
Above Median	44	56

NINE HOUR SIMULATOR ERRORS COMPARED TO
FINAL PERIOD DRIVING ERRORS

% Students by Errors in Simulator	% Students by Final Period Car Errors	
	Below Median	Above Median
Below Median	54	46
Above Median	46	54

NINE HOUR SIMULATOR ERRORS COMPARED TO
TIMES TO PASS STATE LICENSE SKILLS TEST

% Students by Errors in Simulator	% Students by Times to Pass Skills Test	
	Once	Twice or More
Below Median	62	38
Above Median	61	39

SIX HOUR SIMULATOR ERRORS COMPARED TO
FOURTH PERIOD DRIVING ERRORS

% Students by Errors in Simulator	% Students by Fourth Period Car Errors	
	Below Median	Above Median
Below Median	51	49
Above Median	47	53

APPENDIX E (CONTINUED)

SIX HOUR SIMULATOR ERRORS COMPARED TO
FINAL PERIOD DRIVING ERRORS

% Students by Errors in Simulator	% Students by Final Period Car Errors	
	Below Median	Above Median
Below Median	59	41
Above Median	39	61

SIX HOUR SIMULATOR ERRORS COMPARED TO
TIMES TO PASS STATE LICENSE SKILLS TEST

% Students by Errors in Simulator	% Students by Times to Pass Skills Test	
	Once	Twice or More
Below Median	78	22
Above Median	62	38

THREE HOUR SIMULATOR ERRORS COMPARED TO
FOURTH PERIOD DRIVING ERRORS

% Students in Errors in Simulator	% Students by Fourth Period Car Errors	
	Below Median	Above Median
Below Median	58	42
Above Median	42	58

APPENDIX E (CONTINUED)

THREE HOUR SIMULATOR ERRORS COMPARED TO
FINAL PERIOD CAR ERRORS

% Students by Errors in Simulator	% Students by Final Period Car Errors	
	Below Median	Above Median
Below Median	58	42
Above Median	42	58

THREE HOUR SIMULATOR ERRORS COMPARED TO
TIMES TO PASS STATE LICENSE SKILLS TEST

% Students by Errors in Simulator	% Students by Times to Pass Skills Test	
	Once	Twice or More
Below Median	68	32
Above Median	58	42

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